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United States Department of Agriculture
Agricultural Research Administration
Bureau of Entomology and Plant Quarantine

THE APPLICATION OF SOIL FUMIGANTS WITH A PLOW

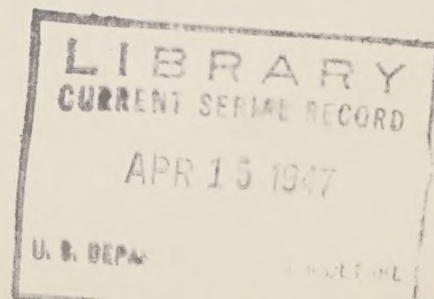
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The recent development of machinery for the mechanical application of soil fumigants (2, 3) has made feasible the treatment of much agricultural land for the control of wireworms. Many fields however, are too small for the economical use of a large injection machine, and often a machine is not available at the best time for soil treatment. For these reasons it is highly desirable to develop a simpler method of application. Carter (1) described the application of D-D mixture (a crude product containing dichloropropane and dichloropropylene) by means of a pump geared to the disk plow wheel, a thin stream of the material being dropped into the bottom of the furrow, just ahead of the plow.

During the summer of 1946 several applicators, by which a fumigant was dropped into the soil ahead of a plow, using only gravity to feed the liquid, were built and used in the Walla Walla, Wash., area. These machines, made by local farmers, were very successful, and experimental work showed them to be at least as efficient as the more expensive injection machines.

The construction of these plow applicators is very simple. A tank of suitable size, usually a second-hand gasoline tank of 10 to 16 gallons' capacity, is mounted on the tractor or plow above the point of application. A line of 1/4-inch copper tubing leads downward from the tank to within a foot or so of the furrow bottom, ahead of the plow. Two standard shut-off valves are installed in the line near the tank. The upper valve serves as a shut-off valve, while the lower, fitted with a set screw to maintain a constant position of the opening, is used to control the rate of flow of the fumigant. One of these applicators installed on a tractor is shown in figure 1.

A valve system used on a two-way-plow applicator is shown in figure 2. The middle valve is a three-way valve, by means of which it is possible to feed the fumigant to one side or the other or to shut off the flow. On each side of the three-way valve is the valve that regulates the rate of flow.



The rate of flow of the fumigant is calculated from the speed of the tractor when the plow is drawn through similar soil, and from the width of the furrow. A flow of 1.8 ml. per square foot will deliver about 20 gallons per acre. Table 1 shows the flow rates for a delivery of 20 gallons per acre for three furrow widths at speeds between 250 and 500 feet per minute.

Table 1.--Flow rates per minute to distribute 20 gallons of fumigant per acre for three furrow widths at various tractor speeds.

Tractor speed	:	12-inch	:	14-inch	:	16-inch
	:	furrow	:	furrow	:	furrow
	:		:		:	
<u>Feet per minute</u>		<u>Milliliters</u>		<u>Milliliters</u>		<u>Milliliters</u>
250		435		507		579
300		521		608		695
350		608		710		811
400		695		811		927
450		782		913		1,043
500		869		1,014		1,159

The cost of the machines so far constructed has been about \$10 each. Since no extra cultivation is involved, there is no extra cost of application. The performance of these plow applicators has been excellent. Delivery with the tank full runs less than 10 percent higher than when it is nearly empty. The tanks used so far have been shallow. If a deep tank, such as a 50-gallon drum, were used, it would probably be desirable to install a constant-level device in the feed line.

As soon as possible after plowing, the fields are harrowed and cross-harrowed, as is the usual practice for obtaining a good seedbed. This produces a firm, even texture of the soil, assuring even penetration of the fumigant. Wireworm mortality has been checked in several fields so treated, caged larvae of the sugar beet wireworm being used. In every field in which 20 gallons (about 200 pounds) per acre of either D-D mixture or 10-percent solution of ethylene dibromide was used, the mortality of wireworms was well above 90 percent. The few living wireworms were found in the top 3 inches of soil. All this work was done on Walla Walla silt loam at soil temperatures above 50°F. at 9-inch depth, and with soil moisture within the ordinary range for good cultivation.

The plow applicator possesses one decided advantage over the cultivator type of injection machine. The passage of the cultivator points through the soil loosens the soil about the lines of passage. A light drag or roller is usually drawn behind the points to seal this opening, but this method is not too successful. Figure 3 shows the soil to a depth of 9 inches, across the path of an injection machine using a railroad rail as a drag. The loosened areas along three injection lines can be detected in the picture. The plow does not leave such loosened areas, except in some places at the bottom of the furrow, covered by the furrow slice. The double harrowing after plowing seals the surface more effectively than does the drag on the injection machine.

LITERATURE CITED

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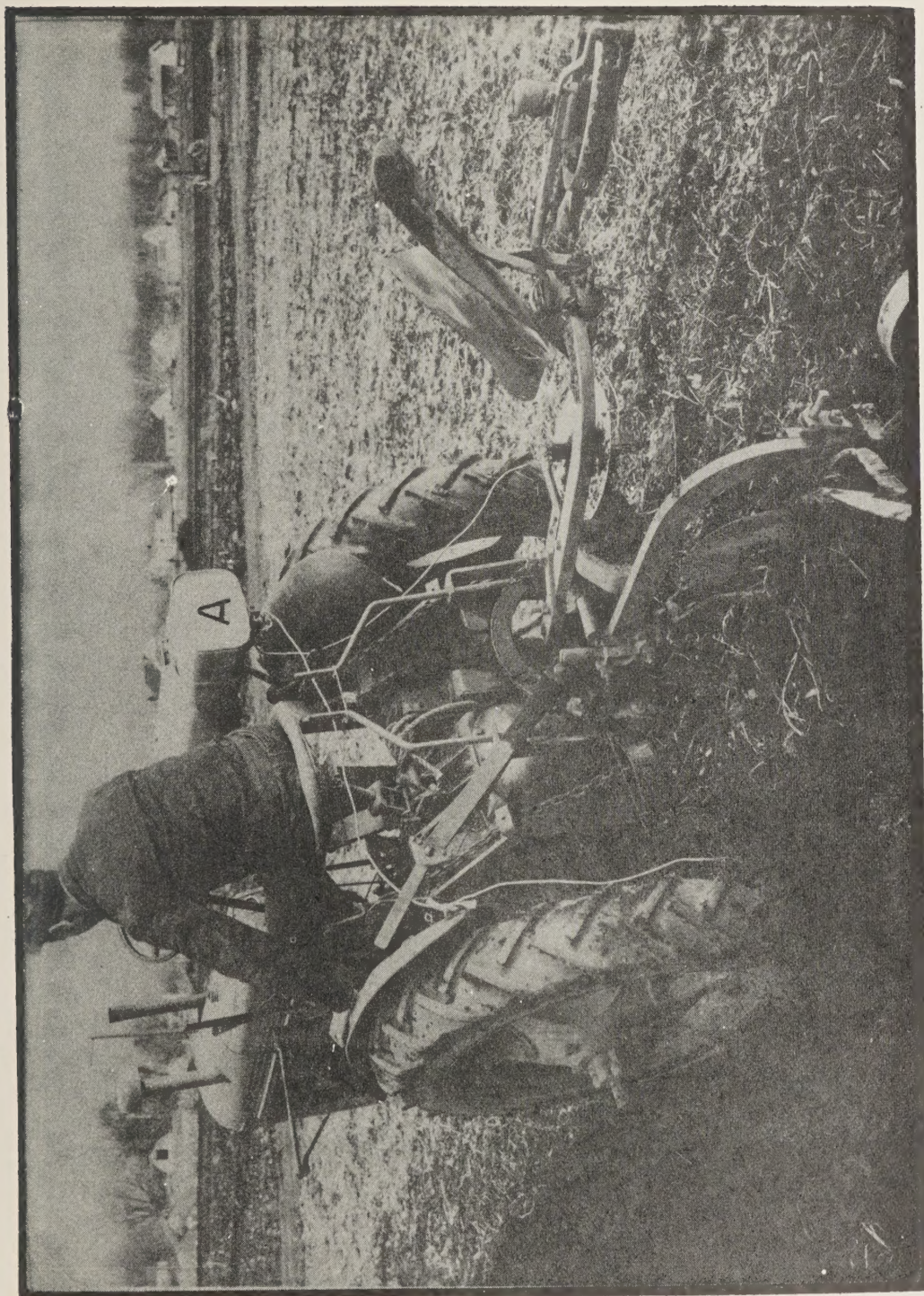


Figure 1.--Two-way-plow applicator showing fumigant tank (A) with tubes leading to the furrow.

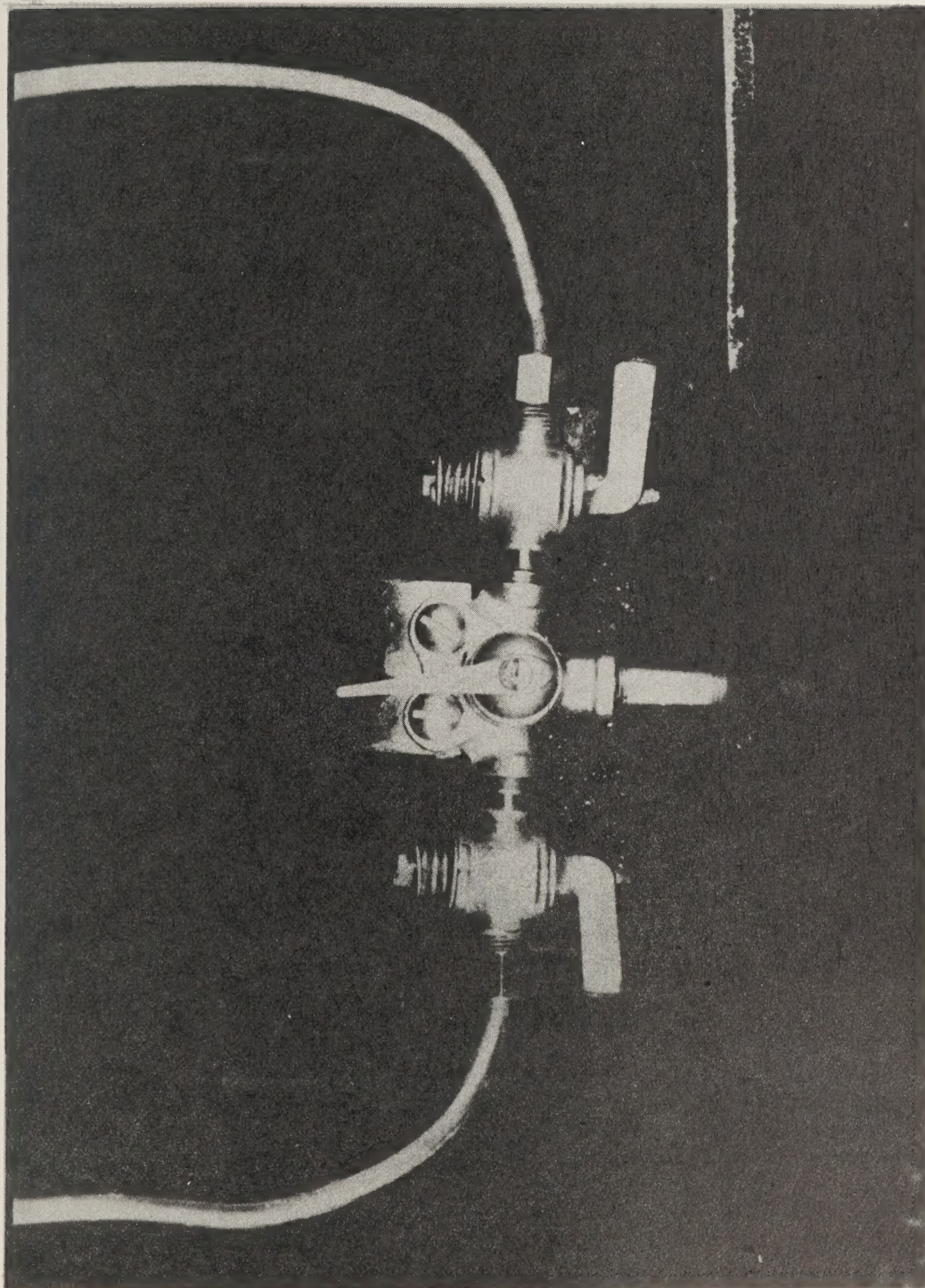


Figure 2.--Valve system used on a two-way-plow applicator for soil fumigants.

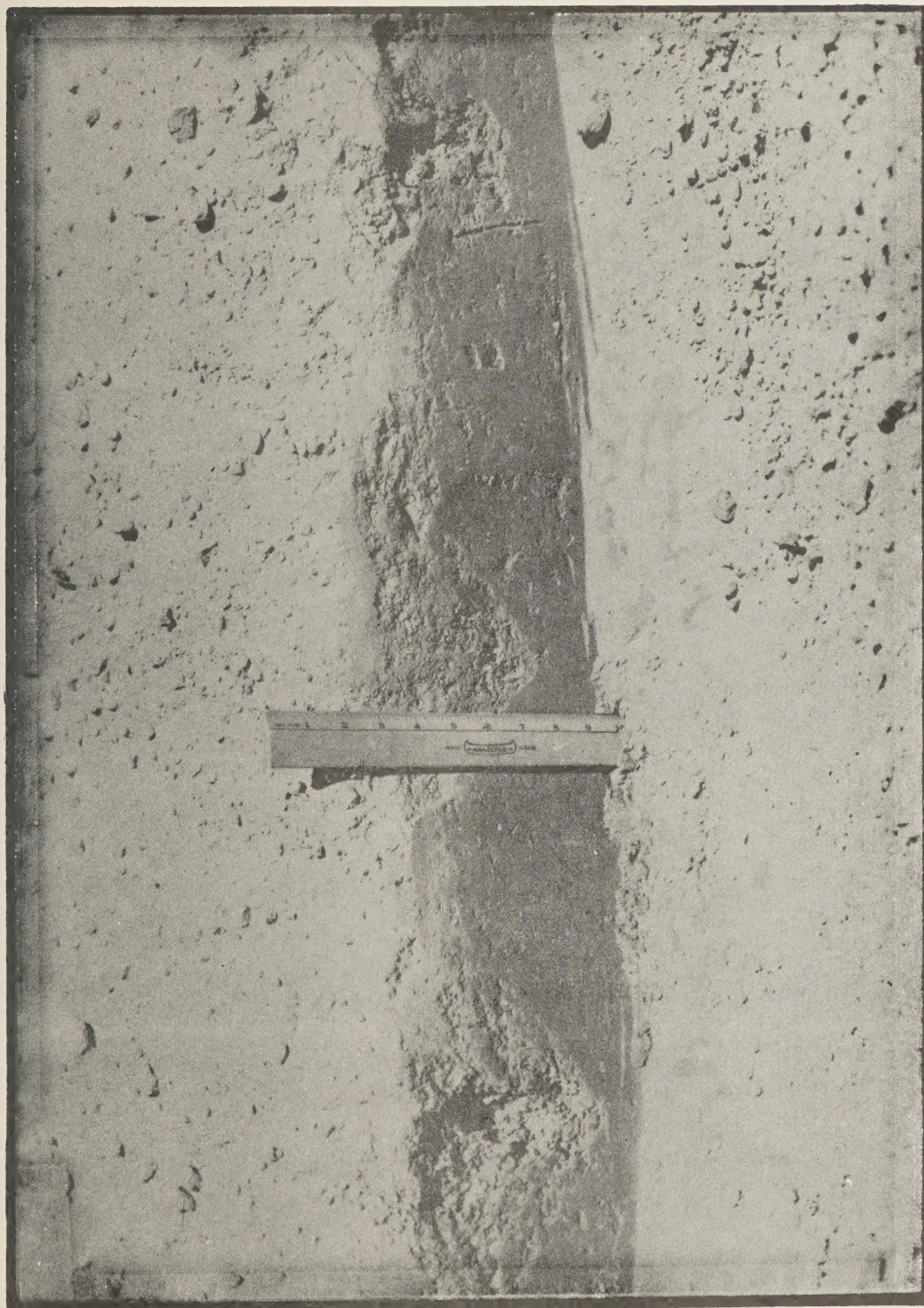


Figure 3.--Section of soil following passage of a cultivator-type injecting machine.

